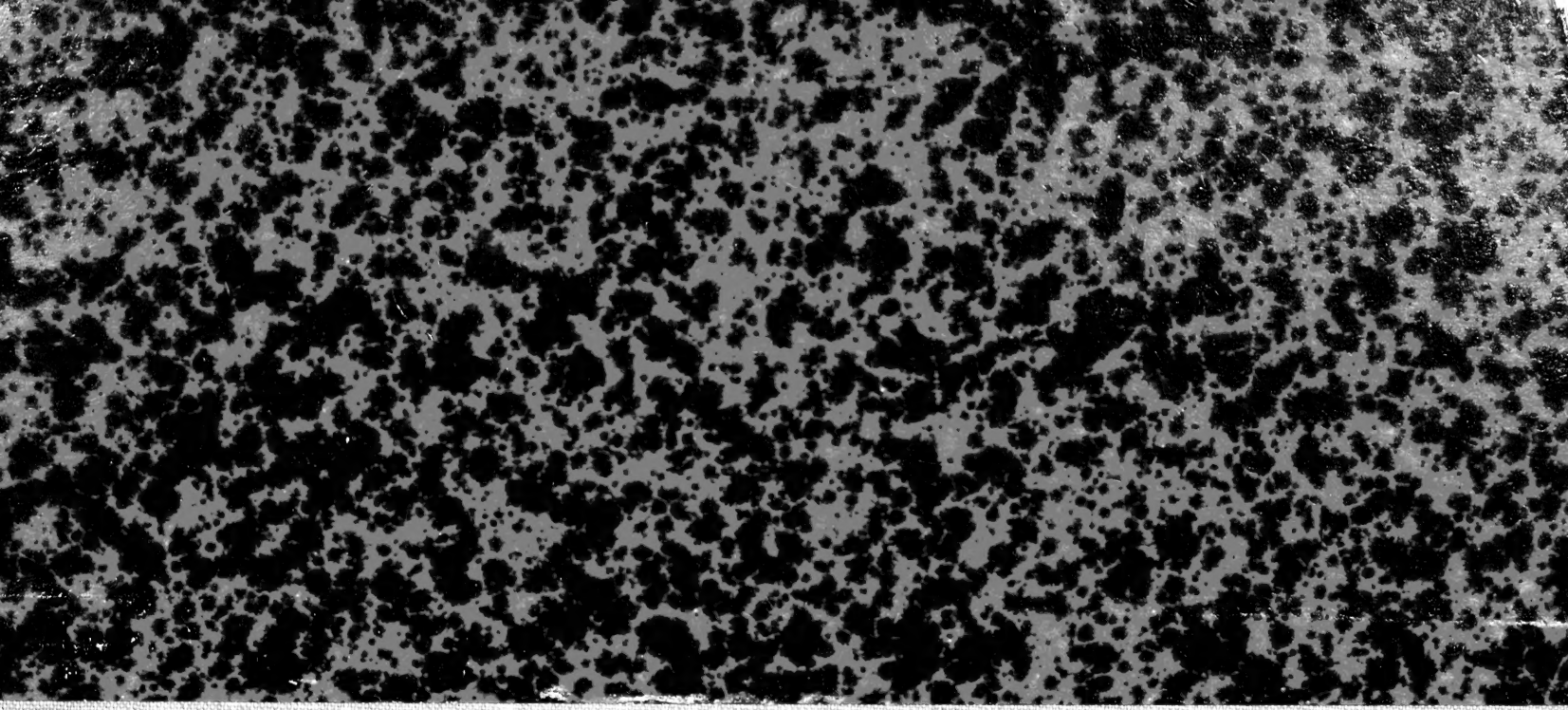

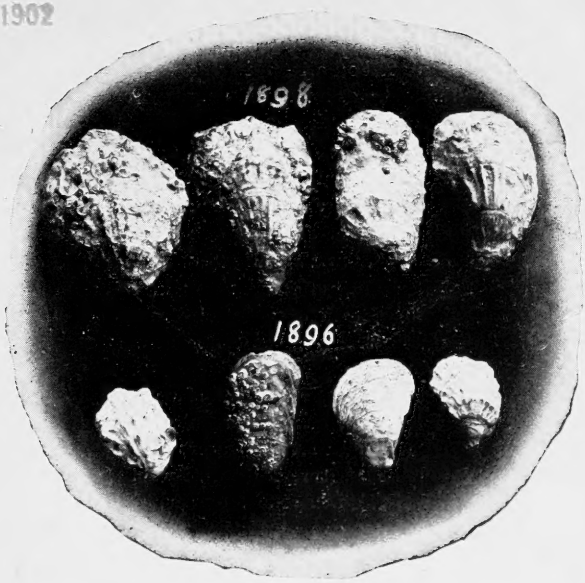

Continuation of Experiment in Propagating Eastern Oysters on the Oregon Coast: Report of work, Summer of 1898.

F. L. WASHBURN A. M.

University of Oregon, Eugene, Oregon.

The following is a brief synopsis of the work done last summer and is a condensation of the more technical report mailed to the U. S. Fish Commission at Washington.

The introduced oysters were found in July to be in excellent condition and spawning. The process of artificial fertilization was agan resorted to, and countless thousands of fertilized eggs and swimming embryos were consigned to the waters of the bay. This process has been fully described; its value lies in the fact that impregnation is assured if eggs are fertilized in the laboratory, and if they are nursed through the early stages there is that much less exposure to conditions occasionally prevailing in the waters of the bay which are unfavorable to their survival. In this connection acknowledgements are due Dr. W. K. Brooks, of Baltimore, whose reports on similiar work have been extremely helpful. This year, convinced that the warmer and less salt water farther up the bay was more suited to the developing spawn, it was for the most part deposited between Oyster City and the so-called "Ship Yard" 2½ miles above the present plant. Some spawn was carried above this point. Further, in the vicinity of the Ship Yard we placed in deep water in

three places a small number of spawning oysters, and later about 200 oysters from the government plant were placed on a breeding float and said float anchored near the Ship Yard. While this float was anchored near Oyster City before being towed to the Ship Yard a very interesting and encouraging thing happened; viz: the water in the float reached a temperature of 70° F. *and the oysters spawned rendering the water milk white.* The oystermen, many of whom are skeptical as regards artificial fertilization, were summoned that they might witness the spontaneous spawning.

The Ship Yard is about nine miles from the ocean and marks the upper limit of the tonging grounds for our Yaquina Bay Oyster (*Ostrea lurida.*) Small specimens of this oyster are found somewhat farther up the stream but they are periodically killed by winter freshets. In this connection it may be mentioned that the eastern oyster can endure much fresher water than our west coast species; in fact it s constantly in such water on its native beds.

Observations on salinity and temperature, surface and bottom at different tides both at Yaquina and Coos Bay corroborate the results of last year's investigations in this direction. It must be confessed that the waters of our bays are occasionally subject to sudden changes of temperature and salinity on different tides which must effect unfavorably the spawn of the introduced oyster, but I do not think this necessarily means the failure of the experiment, since, if the spawn should start to develop in a favorable period, it may have passed beyond its tender, critical stage before meeting the fatal conditions alluded to. It should be borne in mind that, in the case of any species of oyster, not every season offers favorable conditions for spawning. Once in every few years, however, it may happen that different natural forces combine favorably and the result is a great abundance of spat (i. e. spawn which has developed and become fixed.)

There seems to be considerable misconception regarding the condition of the eastern oysters which have for so many years been shipped from the eastern coast to San Francisco Bay. Many think that they do not spawn there while some do not hesitate to declare that their progeny is most abundant, so much so as to materially affect shipments in recent years. As a matter of fact, the introduced oyster does spawn there and the spawn develops; a considerable number of eastern oysters, spawned and developed there, being frequently found; but I am led to believe, from what I hear from an authority in a position to obtain accurate information regarding the shipments of the bivalves, that the production has not been great enough to materially affect importations from the east.

It might be mentioned incidentally, tho' it has no bearing on the eastern oyster question, that large shell heaps of our west coast oyster found on the shores of Coos Bay give proof that many years ago this oyster which now flourishes at Yaquina, Netarts, Shoalwater Bay and elsewhere lived and flourished there until annihilated by some sudden catastrophe, possibly an unusually destructive freshet bringing into the bay a large amount of mud.

The oyster industry at Yaquina Bay is not what it used to be, and I have on several occasions pointed out to the oystermen there that the number of native oysters on their planted beds might be increased by the use of brush collectors, to catch any drifting spawn, which, lacking something to catch on, settles on another's bed or on public ground. They are not disposed, however, to adopt new methods and content themselves with the old and good, but insufficient method of strewing clean shells on the beds.

Future Prospects of the Experiment.

In commenting upon the attempt to introduce the eastern oyster, the press of

the state has run the gamut from declaring it an absolute failure to promising our citizens an abundance of this delicious bivalve grown in Oregon within a year or two. The wiser course to pursue, regarding the effort as purely an experiment, is to avoid the Scylla of pessimism and the Charybdis of extravagant hopes. The outcome of the experiment can not be even partially decided for two years from now. No eastern spat from the spawning of a year ago, was found this summer. It is too soon to observe results of this year's spawning. I am so confident that we shall eventually discover spat of the eastern oyster that I have this fall offered a prize to the individual who first sends me living spat of *Ostrea Virginica* found in Yaquina Bay. The spawning of the oysters on the float when taken from the government plant has already been alluded to as an encouraging sign. I was more particularly impressed by the following. In the laboratory experiments in artificial fertilization one set of eggs was started in water from the bay which registered 1.022, *almost ocean saltness*. Two days later microscopic investigation revealed numerous swimming embryos. The water was exposed during that time to the varying temperature of the laboratory, from 59° F. to 70° F. *This speaks well for the hardiness of the young spawn and for possibilities on the planted beds at Oyster City.*

The oysters were in far better condition this season than during their first summer here, showing that they are becoming acclimated. It may not be generally known that two varieties of the eastern oyster were sent us in 1896,—a somewhat elongated variety from East River, New York, and a round variety from Long Island Sound, called Princess Bay. The latter coming from a locality nearer the sea has done better than the East Rivers. Unfortunately only a small proportion of the twenty-two barrels was represented by this variety. We have grounds for hope that the Fish Commission will send us more Princess Bay oysters this season.

If money were available to make salt ponds where the proper conditions as regards temperature and saltness could be maintained, eastern spat could be raised artificially in very large numbers. Assuming that this is not feasible, the experiment resolves itself into a question of Natural Selection. That is, some spawn, as time goes on will undoubtedly, inheriting the acquired hardiness of their parents, pass successfully through the tender and critical period and become attached as spat to rocks, shells, etc., in Yaquina Bay. Their progeny, parent and offspring having become acclimated, as it were, will be more likely to develop in large numbers than their ancestors, so that, eventually the bay will be more or less stocked with the bivalves. To what extent and how long it will take is, of course, a matter of conjecture. Judging from the conditions prevailing in San Francisco Bay, where oysters have been planted for years, it would be the safest plan not to expect too much from our experiment. As a cause of encouragement, however, we have the fact that at San Francisco they have made no such efforts toward this end as we have here. The experiment is well worth the very small sum it has cost the government; it has cost the state nothing.

The upper row of oyster shells, in the photograph which heads this report, have lost, in transportation and in handling, about ½-inch or more of delicate growth not yet hardened, marking their increase during the latter part of this season.

These oyster, like all the fish interests of the state are under protection of the State Fish Commissioner who will see that a special bill for their protection is presented at the coming session of the legislature. It is the intention of the U. S. Fish Commissioner that the present plant be always preserved as a spawning plant, and

that, after a stated time, the progeny of the introduced specimens, if there be any, may be lawfully marketed.

My thanks are due to Mr. George King, of Oyster City, for much volunteer labor and assistance in the experiment.

What is an Oyster?

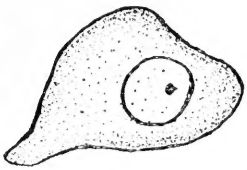

Fig. 1.

The old conundrum and its answer, "Why is an oyster like an elephant? Because neither can climb a tree," does not, strangely enough, convey a sufficiently clear idea of the oyster's anatomy and life history to satisfy the mind of the average citizen, and I have been asked by friends to tell what oysters are and something about their habits.

The animal sub-kingdom known as *Mollusca* contains the snails, clams, oysters, devil fish, &c.,—animals which have very soft bodies which may or may not be protected by a shell. In this sub-kingdom occur several classes, one of which the *Lamellibranchiata*, (i. e. Mollusca furnished with plate-like gills) includes the clams and oysters, in other words, all the bivalves. The oyster family, *Ostreidae*, belonging to this class contains all the oysters in whatever part of the world they may live; the small oyster of our northwest coast, the so-called eastern oyster, the European oyster, the pearl oyster, etc. All possess certain characteristics in common which place them in the same family. Furthermore, the genus *Ostrea*, one division of the family, includes more than 70 species, of which our west coast oyster, *Ostrea lurida* and the eastern oyster, *Ostrea Virginica* are the two forms we are most interested in. Lastly, the eastern oyster takes different shapes and reaches different sizes in different localities and receives different colloquial names, East Rivers, Princess Bays, Baltimores, Blue Points, &c., but these are all the same species whether they are found in the deep cold water of the Gulf of St. Lawrence or in the warmer waters of the Gulf of Mexico. All oysters love a bottom of shell and mud, or gravelly mud, not too soft, for in such they would become smothered. In the spawning season the optimum temperature for the eastern oyster is between 70° and 80° F., and they are accustomed as a rule to much fresher water than is our west coast oyster.

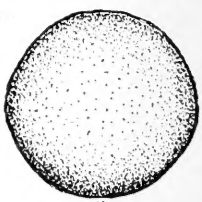

Fig. 2.

The eggs of the eastern oyster when first laid are irregular in shape and each egg is about 1-500 of an inch in its longest diameter. (See Fig. 1.) These eggs are ejected into the water while our oyster (*Ostrea lurida*) retains its eggs inside of ts shell until the embryos are far along in their development. As if to compensate for the lack of protection in the former species, a very careful estimate places the number of eggs laid at one spawning by a single eastern oyster at 60,000,000 (only a very small portion of them survives) while our small oyster lays only between one and two millions. If the egg of the eastern oyster floating in the water, does not shortly meet a sperm cell it quickly dies. About two hours after being fertilized it becomes round (Fig. 2) and shortly begins to segment, forming 2, then 4, then 8, then 16 cells and so on.

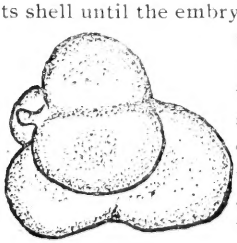

Fig. 3.

At an early stage of segmentation it looks something like Fig. 3, the two polar globules being still seen attached to the egg. Fig. 4 shows the result of this rapid cell division, and Fig. 5 a little later period than that shown in Fig. 4.—27 hours after impregnation and just previous to the swimming stage shown in Fig. 6. At this period, thirty hours after fertilization, the embryo moves rapidly through the water by means of the cilia or hair-like growths shown in the figure. All of these stages can be readily seen under the microscope and were observed repeatedly by the writer in his seaside laboratory. Figure 7 shows an oyster embryo at a considerably later date. 2 to 4 days after fertilization, with its delicate transparent shell showing, the alimentary canal and the mouth. When the oyster embryos are at the stage shown in Fig. 6, they crowd to the surface in large numbers. It is at this time that they are exposed to the greatest dangers, to the danger of being eaten by small fish, danger from change of air temperature, &c. Hence the value of artificial fertilization and subsequent care in the laboratory, in which process they need not be consigned to the outside waters until they have passed the critical period alluded to. It is important, therefore, that this process should be resorted to every season until the introduced species has obtained a foothold.

Fig. 4.

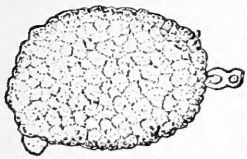

Fig. 5.

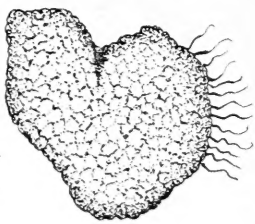

Fig. 6.

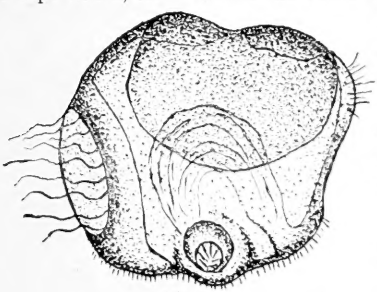

Fig. 7.

Later, when they have acquired their delicate shells, they sink to various depths and are less liable to fatalities. It is not, however, until they have swum about for from 6 to 8 days that they settle on a piece of clean shell, or piece of crockery, a brick, old shoe or rubber, clean wood or rock, anything in fact that is not slimy and there become fastened as *spat* (Fig. 8.) never to move from that place of their own accord. The spat of the eastern oyster when first formed is about 1-80 inch in diameter. They are hardly marketable before they are four years old and may under favorable conditions live for 20 years or more. The spat are very apt to form in clusters on other shells. Tonging brings these clusters to the surface and the oysters are separated, the larger specimens are marketed, the smaller individuals being placed upon private beds to attain greater size. Hence we see in markets and in restaurants single oysters and not clusters, nor are we apt to see the original object to which each oyster was first attached as a spat.

Fig. 8.

Biological Laboratory, Nov. 20, 1898